

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

REC'D 25 APR 2006

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Applicant's or agent's file reference 55095PCT KMC:PFB	FOR FURTHER ACTION See Form PCT/IPEA/416	
International application No. PCT/AU2004/001766	International filing date (day/month/year) 16 December 2004	Priority date (day/month/year) 18 December 2003
International Patent Classification (IPC) or national classification and IPC Int. Cl. H02K 1/14 (2006.01) H02K 1/02 (2006.01)		
Applicant INTELLIGENT ELECTRIC MOTOR SOLUTIONS PTY LTD et al		

<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> (sent to the applicant and to the International Bureau) a total of 12 sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input checked="" type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>	
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the report</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>	

Date of submission of the demand 8 September 2005	Date of completion of this report 18 April 2006
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer MANO RAMACHANDRAN Telephone No. (02) 6283 2166

Box No. I Basis of the report**1. With regard to the language, this report is based on:**

- ☒ The international application in the language in which it was filed
- ☐ A translation of the international application into _____, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3(a) and 23.1 (b))
- ☐ publication of the international application (under Rule 12.4(a))
- ☐ international preliminary examination (Rules 55.2(a) and/or 55.3(a))

2. With regard to the elements of the international application, this report is based on (replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):

- ☐ the international application as originally filed/furnished
- ☒ the description:
pages **1, 5, 6** as originally filed/furnished
pages* **2, 3, 3/1** received by this Authority on **7 December 2005** with the letter of **7 December 2005**.
pages* **4, 7** received by this Authority on **3 April 2006** with the letter of **3 April 2006**.
- ☒ the claims:
pages as originally filed/furnished
pages* as amended (together with any statement) under Article 19
pages* **8, 9** received by this Authority on **7 December 2005** with the letter of **7 December 2005**.
pages* received by this Authority on with the letter of
- ☒ the drawings:
pages as originally filed/furnished
pages* **1-5** received by this Authority on **3 April 2006** with the letter of **3 April 2006**.
pages* received by this Authority on with the letter of
- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages
- ☐ the claims, Nos.
- ☐ the drawings, sheets/figs
- ☐ the sequence listing (specify):
- ☐ any table(s) related to the sequence listing (specify):

4. ☒ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☒ the description, pages **4, 7** filed on **3 April 2006**.
- ☐ the claims, Nos.
- ☒ the drawing sheet **5** filed on **3 April 2006**.
- ☐ the sequence listing (specify):
- ☐ any table(s) related to the sequence listing (specify):

* If item 4 applies, some or all of those sheets may be marked "superseded."

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 4	YES
	Claims 1-3,5-10	NO
Inventive step (IS)	Claims	YES
	Claims 1-10	NO
Industrial applicability (IA)	Claims 1-10	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

D1: WO 2003/075432 A2

D2: JP 2001-157390 A1

D3: JP 10-014145 A

NOVELTY (N) claims 1-3, 5-10:

Citation D1 discloses all of the features of the above claims. Referring to this citation: an electrical machine including a stator frame formed of steel laminations [page 4, paragraph 4, lines 2, 3, fig 13, item 612], pole pieces having non-laminar construction formed of bonded iron [page 8, paragraph 3, lines 3, 4, page 5, paragraph 1, lines 2-6, fig 13, item 618] attached to the stator frame [page 8, paragraph 6, lines 1, 2], stator frame protects the pole pieces [fig 13], stator coils wound substantially about the pole pieces of non-laminar construction [fig 13], are as claimed in claims 1-3, 5-10.

INVENTIVE STEP (IS) claims 1-10:

Claims 1-3, 5-10: As above.

Citation D2 discloses all of the features of claims 1-3, 5-10 except that each of the pole pieces of the citation is formed of laminar and non-laminar construction instead of non-laminar construction. This difference between the claimed invention and the disclosure of the citation merely amount to common general knowledge and does not involve an inventive step.

Citation D3 discloses a stator frame with a non-circular internal profile as in claim 4.

Hence when the disclosure of citation D1 or D2 is combined with that of citation D3 as would be obvious to a person skilled in the art disclose all of the features of claim 4.

Hence the invention claimed in claims 1-10 lacks an inventive step.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of Box I:

Fig 5 and its description in page 4, lines 26, 27, page 7, lines 1-10 is not included in the originally filed specification.

Laminations are used to provide an anisotropic core. Electrical steel, from which the laminations are traditionally made, has low electrical resistance. It cannot be
5 employed in an isotropic form.

An alternative solution to the problem of eddy currents is the use of "bonded iron" or soft magnetic composite to form the core. This material is known by the trade name of "Somaloy", "FM-CM" or "Permedyn". This material has magnetic properties suitable for use as a coil core, combined with high electrical
10 resistance. It allows an isotropic core (3D) to be constructed which does not suffer from the problem of excessive eddy currents.

However, in many electric machines, the stator serves more than electrical and magnetic purposes. It also provides the mechanical frame of the machine. The mechanical properties of bonded iron (strength TRS in the range 40-100Mpa)
15 are inferior to those of electrical steel. Somaloy or Permedyn has 10% the impact strength of electrical steel. A typical 56 frame motor has a radial load of 41kgs. A Somaloy frame motor has a maximum radial load capacity of 10kgs. Further, mechanical fabrication of solid stators with complex internal profiles as
20 may be required for optimum positioning of windings within the stator is expensive. On the other hand, components from dies can have intricate shapes with smooth curvatures and excellent surface finishes. Laminations can be cheaply pressed out in a great variety of shapes.

DISCLOSURE OF THE INVENTION

25 Accordingly we have discovered that both types of core material can indeed be used jointly and this provides significant advantages both electrically and mechanically. By having some of the structure being of laminate construction and some that is suitable for being a core but is of non laminar construction allows for complex shapes and efficiencies to be achieved that have not been
30 previously thought to be possible.

In one form of this invention although this may not be the only or indeed the broadest form of this there is proposed an electric machine which includes at
5 least one magnetically inducible structure, said structure comprising at least two magnetically inducible portions, at least one said portion being of laminar construction and at least another said portion being non-laminar in construction.

In the alternative there is provided an electric motor or generator having a stator and a rotor, characterised in that in at least the stator has at least one coil and
10 a core that is magnetically inducible from said coil where the core has at least two parts where one of the parts is of laminar construction and provides a rugged support and a further part is of non laminar construction.

In preference, the laminar portion is arranged to be in a location where its more rugged mechanical strength is effective to protect the other less rugged non-
15 laminar portion.

In preference the non-laminar portion is positioned so that it is protected by laminar materials of more rugged construction.

In preference, the magnetically inducible structure is a stator of an electric machine.

20 A significant advantage of a hybrid stator with both laminated and non-laminated portions is that it combines the mechanical properties of a laminated stator with the ease of construction of a solid stator.

In preference the laminar portion is a frame of a stator of an electric machine typically a motor or generator.

25 In preference, the non-laminar portion is a pole piece of a stator of an electric machine.

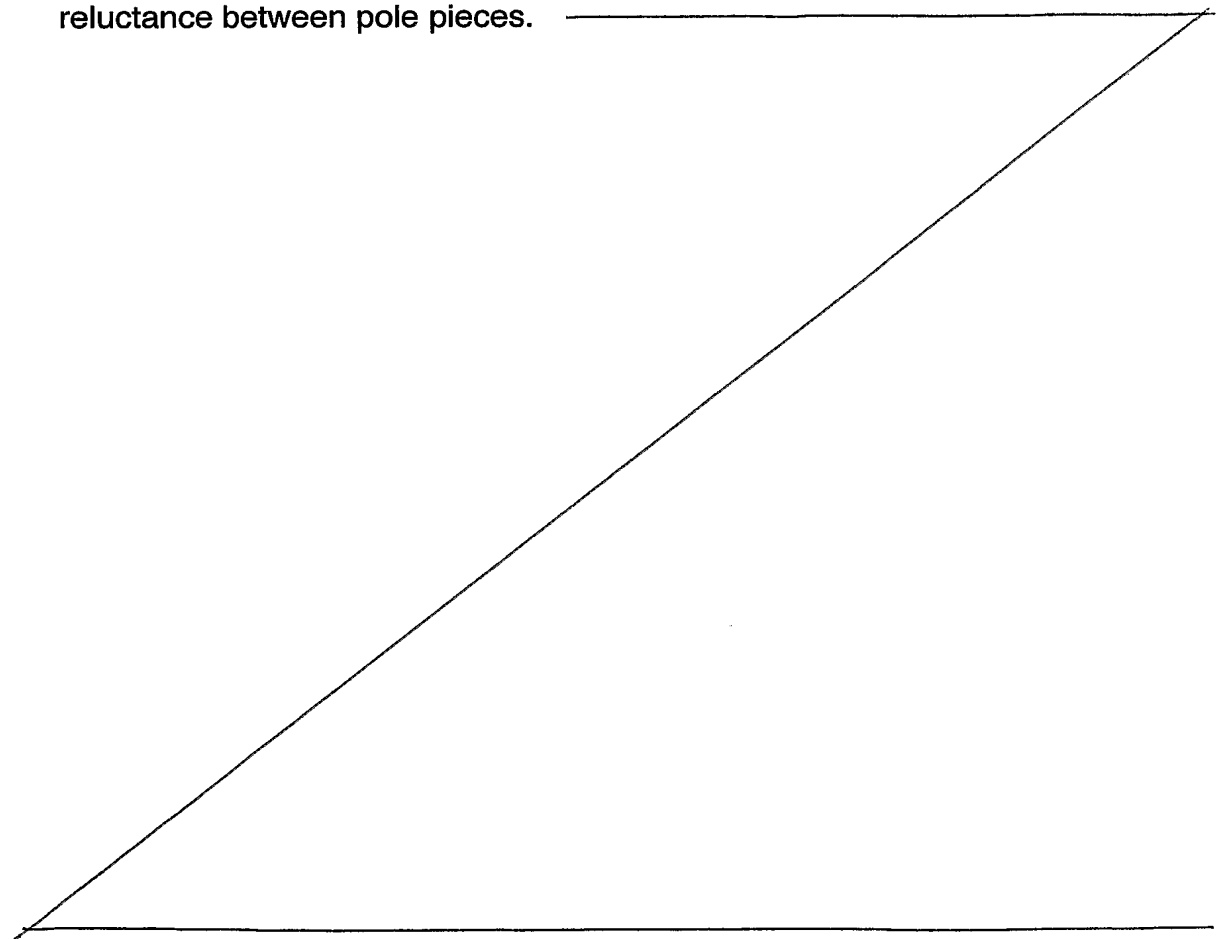
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The non-laminar portion has low eddy current losses and hysteresis losses less than laminated at medium motor frequencies.

- 5 In preference, a frame or back-iron of the machine is constructed from electrical steel.

In preference, pole pieces of the machine are constructed from bonded iron.

- 10 Electrical steel has low electrical resistance and thus is conventionally in a laminated construction when used as a magnetic core in order to reduce eddy currents. Bonded iron has high electrical resistance and can be used as a solid piece as a magnetic core. The low electrical resistance aids to balance the reluctance between pole pieces.



CLAIMS

- 5 1. An electric machine including a stator frame of laminar construction to which are attached pole pieces of non-laminar construction, the laminar construction being of greater mechanical strength than the non-laminar construction, the stator frame being arranged to be in a location where its greater mechanical strength is effective to protect the pole pieces and the stator
- 10 coils are wound substantially about the pole pieces of non-laminar construction.
2. An electric machine as in claim 1 wherein the laminar portion is constructed from electrical steel.
- 15 3. An electric machine as in claim 1 wherein the non-laminar portion of the machine is constructed from bonded iron.
4. An electric machine as in claim 1 wherein each lamination of the frame is of such a shape that, when assembled into the frame, the internal profile of the frame is non-circular in such a way as to maximise the amount of space
- 20 available for a stator coil.
5. An electric machine as in any one of the preceding claims wherein the electric machine is an electrical motor.
6. An electric machine as in any one of the preceding claims wherein the electric machine is an electrical generator.
- 25 7. An electric machine as in any one of the preceding claims wherein the electric machine is an electrical transformer.
8. A electrical machine of the salient-pole type, wherein the stator of the electric machine comprises a frame supporting salient pole pieces, characterised in that the frame is constructed from laminated electrical steel and
- 30 the pole pieces are constructed from bonded iron.

9. A method of constructing an electric machine which includes the steps where approximately annular laminations are pressed from magnetically
- 5 inducible, mechanically strong material,
said laminations are assembled into a frame,
and pole pieces made from a magnetically-inducible material of high electrical resistance are attached to said frame,
and rods are wound substantially about said pole pieces.
- 10 10. An electric machine substantially as described in the specification with reference to and as illustrated by any one or more of the accompanying drawings.

In preference, each lamination of the frame is pressed in such a shape that, when assembled into the frame, the internal profile of the frame is non-circular in such a way as to maximise the amount of space available for a stator coil.

5 In preference the electric machine is an electrical motor.

In preference in the alternative the electric machine is an electrical generator.

In preference in the alternative the electric machine is an electrical transformer.

The invention in a further form may be said to reside in a method of constructing an electric machine which includes the steps where approximately annular
10 laminations are pressed from magnetically inducible, mechanically strong material,
said laminations are assembled into a frame,
and pole pieces made from a magnetically-inducible material of high electrical resistance are attached to said frame.

15 For a better understanding of this invention it will now be described with reference to a preferred embodiment which shall be described herein with the assistance of the drawings wherein;

BRIEF DESCRIPTION OF THE DRAWINGS

20 Figure 1 is a perspective view of an electrical machine constructed according to a preferred embodiment of the present invention; and

Figure 2 is plan view of the electrical machine of figure 1; and

Figure 3 is a cross-section of the electrical machine of figure 2; and

Figure 4 is a plan view of a lamination of the stator of the electrical machine of

25 Figure 1; and

Figure 5 is a plan view of a 12 pole salient pole machine embodiment of the invention.

Figure 5 is a plan view of a 12 pole salient pole motor made in accordance with the current invention. There is a stator frame 52 which is constructed from laminated electrical steel. This surrounds 12 salient pole pieces 53 which are of bonded iron construction. These form a self supporting ring but are attached to the laminated stator frame by a slot and cleat arrangement 56. There is a central rotor 55 within the ring of salient pole pieces.

Coils which are not shown for clarity are around the web 54 of the salient pole pieces 53.

The purpose of this description is to describe the invention and not to limit this.

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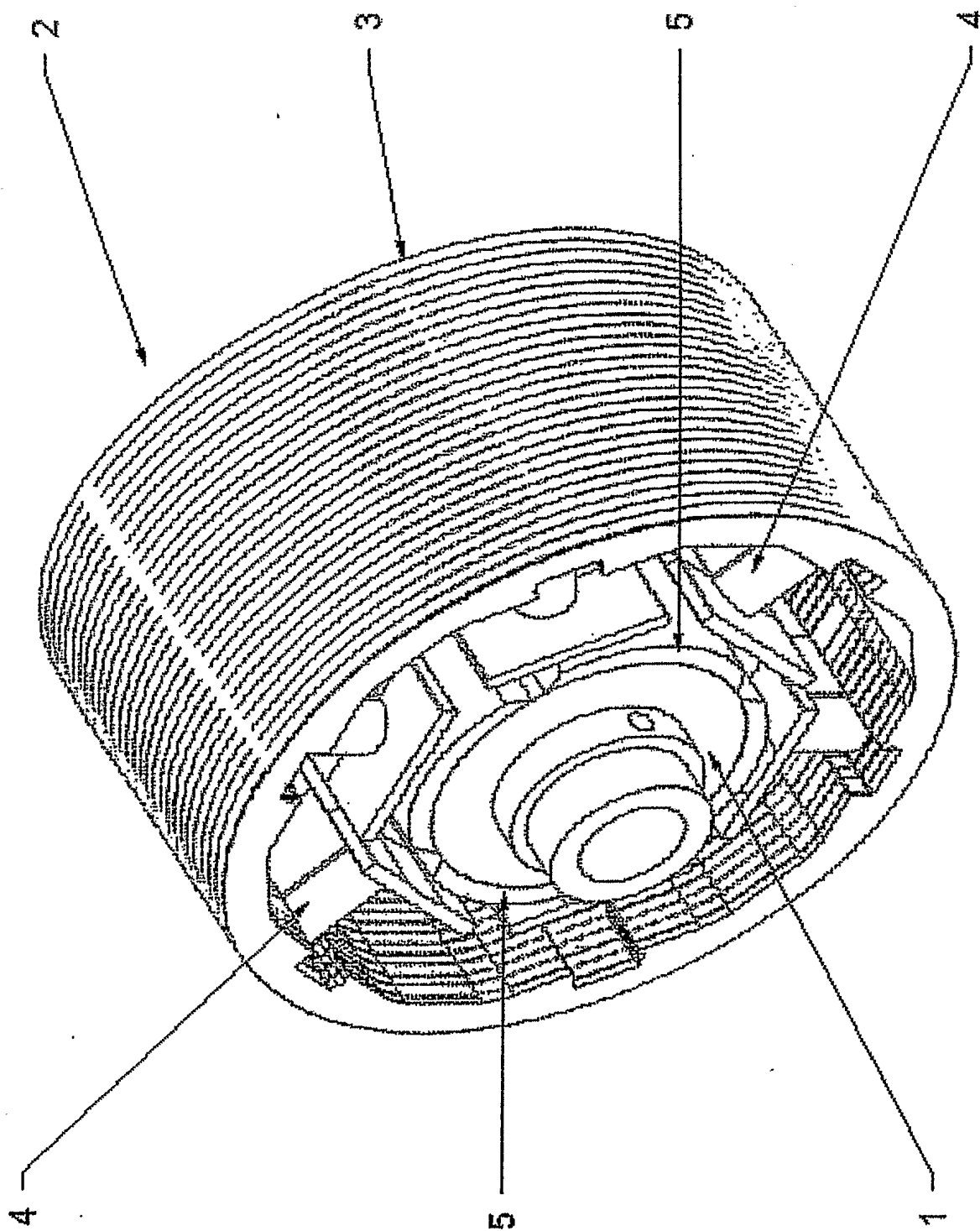


Fig 1

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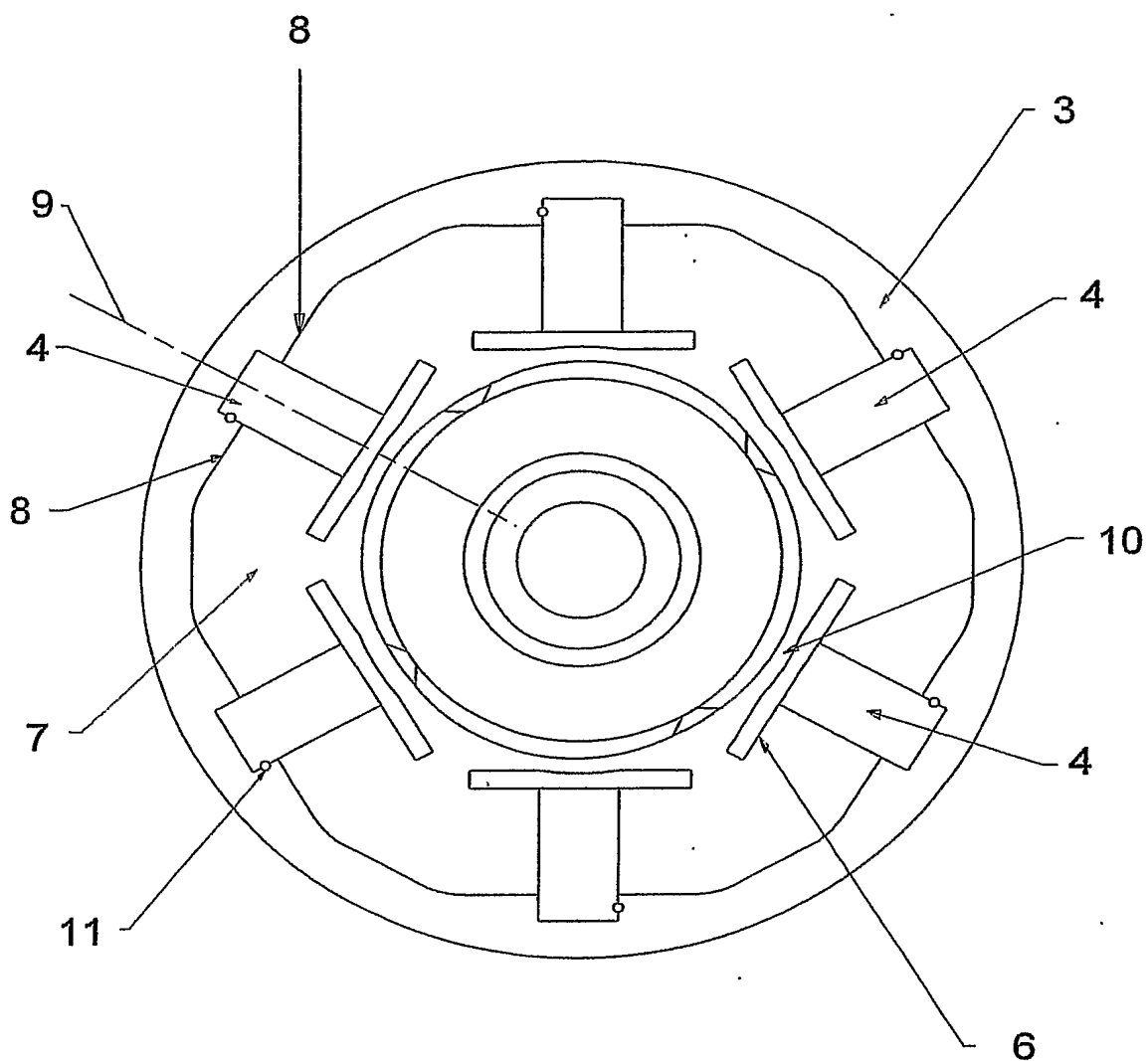


Fig 2

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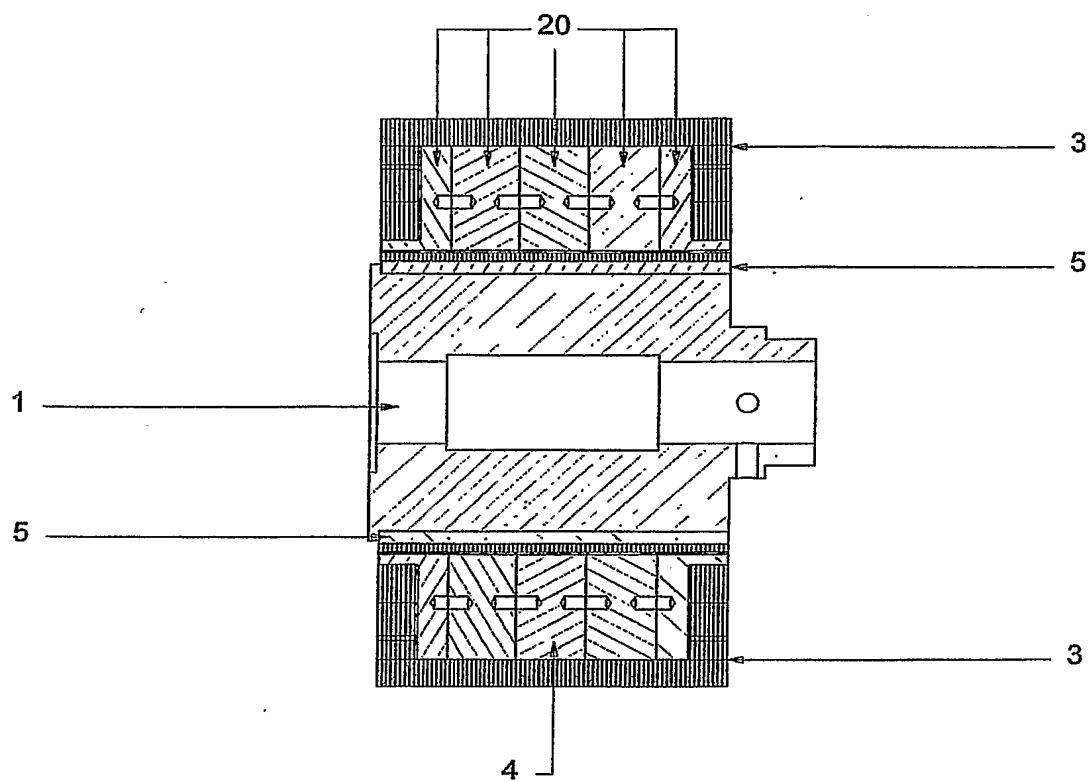


Fig 3

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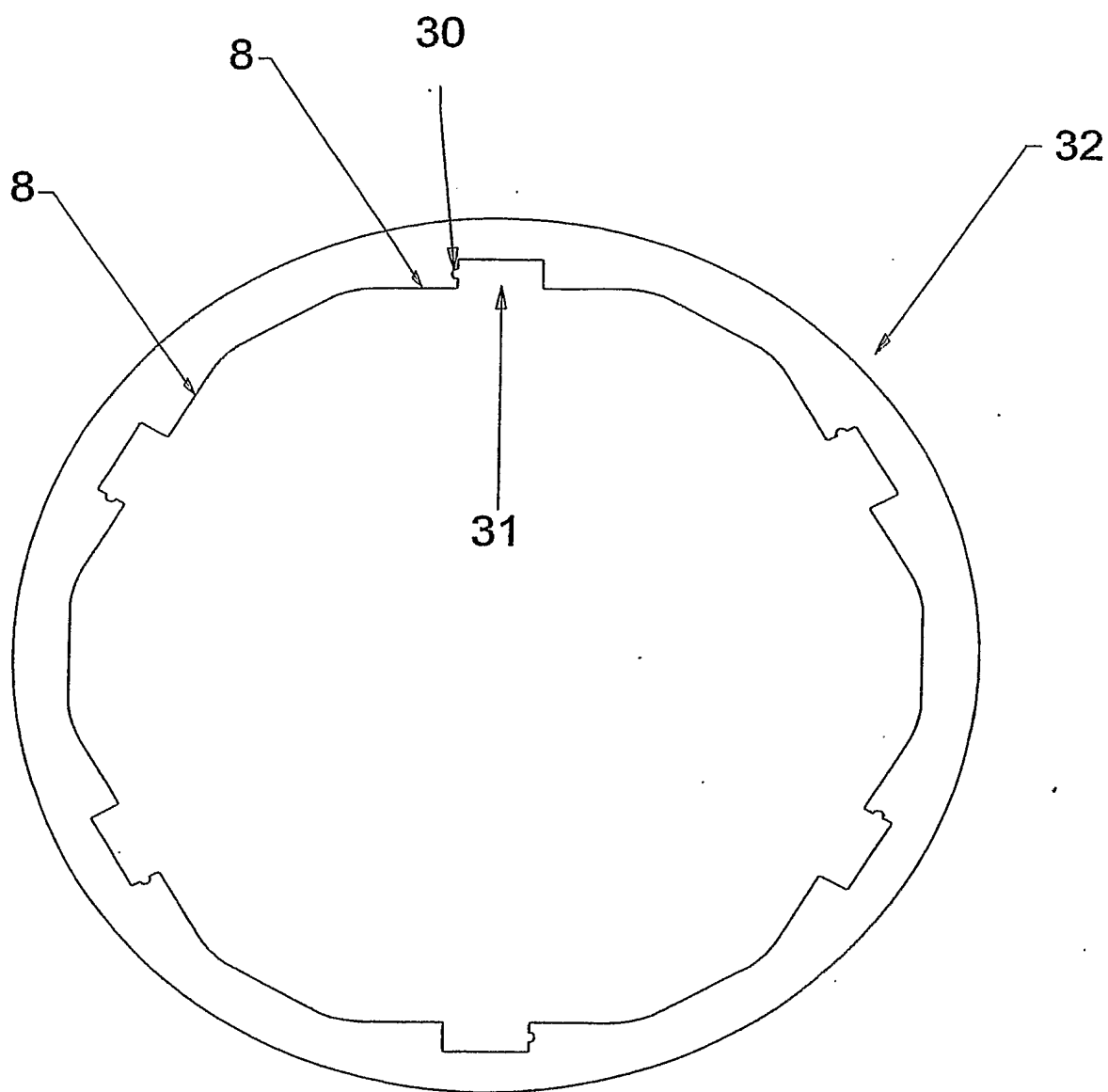


Fig 4

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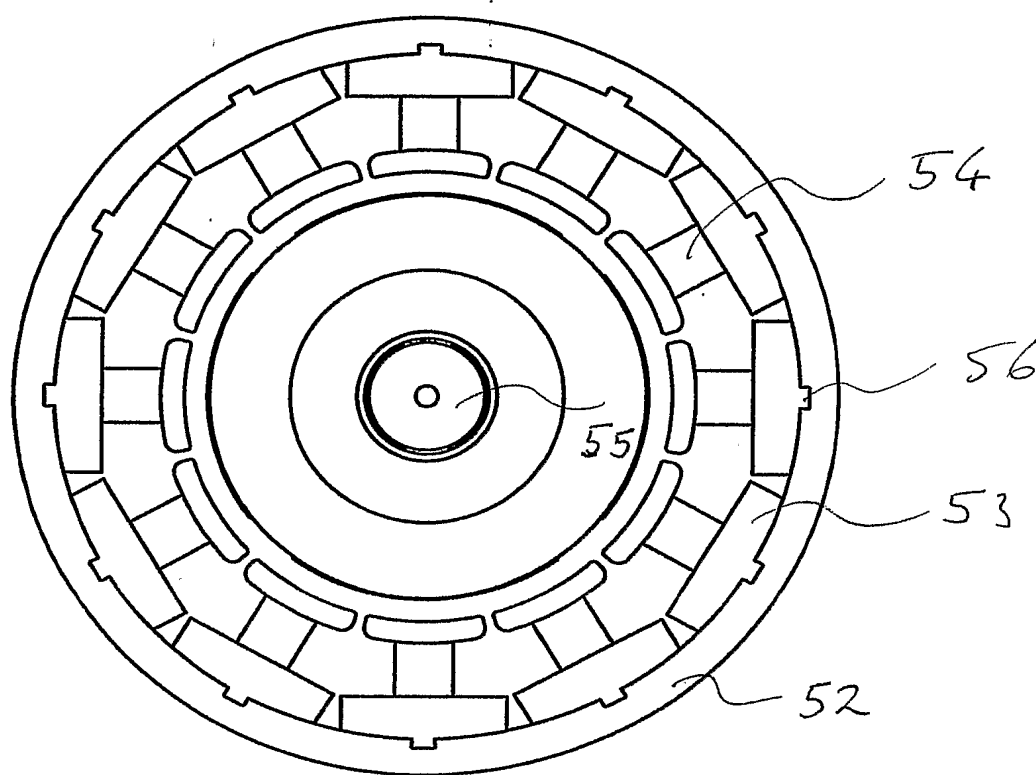


Fig 5